

SUPPORT FOR THE AMENDMENTS

Support for the amendment of Claim 14 is found in Examples 1-6 of the specification and in the original description of the claim.

No new matter is believed added to this application by entry of this amendment.

Upon entry of this amendment, Claims 14-16, 18, 19, 21, 22, 24 and 26 are active.

REMARKS/ARGUMENTS

The claimed invention is directed to a quartz glass crucible for the preparation of silicon single crystal via a method such as the Czochralski process. The claimed invention provides a surface modified quartz glass crucible having a transparent coated layer which is not abraded upon contact with handling instruments or persons, has sufficient durability, and also provides a process for the surface modification.

Improvement of conventionally surface treated quartz glass crucibles is sought because barium carbonate powder applied on the surface of the quartz glass crucible is not fixed with any binder and therefore, the adhesion strength of the powder is very weak so that the powder is easily abraded and falls off when contacted by persons and instruments. Such abrasion occurs in the production process of the crucibles, such as product inspection, conveyance, and insertion to a carrying case, etc. It also occurs in the single crystal production facility, where the quartz glass crucible is set on a carbon susceptor in the pulling equipment. As a result, its adhesion state becomes non-uniform and spot-like. Furthermore, worker health may be negatively affected because the non-adhered barium carbonate powder can be scattered when the carrying case is opened. Since the adhesion strength of the powder is very weak, nucleation efficiency as a crystallization accelerator is low, and so the amount of barium carbonate required becomes excessive. If the crucible is washed, the barium carbonate powder adhered on the surface of the crucible is washed away. It is then

impossible to wash the crucible after the adhesion of the barium carbonate powder, which may be a problem if the surface of the crucible becomes soiled by contaminant which would lead to dislocations in the silicon single crystal.

Applicants respectfully note that Claim 14 is herein amended to recite that at least the inside surface comprises a transparent coated layer consisting of a crystallization promoter and a silica matrix. This description is supported by the descriptions of Examples 1-6 in the specification.

Accordingly, the surface modified quartz glass crucible of the present invention has a hard and transparent coated layer, in which the metal oxide or the metal carbonate is dispersed in a silica matrix, on the whole or a part of the inside and/or outside surface of the crucible. In addition, the metal oxide or metal carbonate acts as a crystallization accelerator to the surface glass layer of the crucible at the high temperature of pulling the silicon single crystal. Therefore, when the crucible is used for pulling a silicon single crystal, a uniform cristobalite layer is formed on the inside surface of the crucible at an early stage of pulling up, and as a result a high dislocation free ratio of the pulled crystal can be obtained. The strength of the crucible under a high temperature is increased by the uniform cristobalite layer formed on the inside or outside surface of the crucible. Moreover, since the coated layer is baked on the surface of the crucible, it is not washed away by acid washing. Impurities on the surface of the crucible can be removed easily by acid washing to prevent the contamination of the silicon single crystal to be pulled.

The rejection of Claims 14-16, 18-19, 21-22 24 and 26 under 35 U.S.C. § 112, first paragraph is obviated by appropriate amendment. The description directed to the thickness of the transparent coated layer is herein deleted. Applicants make no statement with respect to the propriety of the grounds of the rejection and preserve the right to present this description

and contest the issue at some future stage of prosecution. Accordingly, withdrawal of the rejection at this time is respectfully requested.

The rejection of Claims 14-16, 18-19 and 21-22, 24 and 26 under 35 U.S.C. 103(a) over Hansen et al. (U.S. 5,980,629) in view of Watanabe et al. (U.S. 6,106,610) is respectfully traversed.

Hansen is directed to a method of reinforcing a crucible for the containment of a molten semiconductor material in a Czochralski process, and of inhibiting formation of dislocations within a single crystal grown by the process. However, Hansen does not teach or indicate that the crystallization promoter is uniformly dispersed in a silica matrix. Hansen describes that a barium salt which is a devitrification promoter adheres to the inner surface of a crucible when the water or solvent in which it is applied is decanted off (Col. 7, lines 42-46). However, Applicants respectfully submit that such applied salt would change upon acid washing of the quartz glass crucible.

Applicants have described the problems associated with a crucible treated in the conventional manner as described by Hansen, beginning on page 1, last paragraph and bridging to page 2. Since the devitrification promoter is not fixed on the quartz glass crucible, the adhesion strength of that layer is very weak and the devitrification promoter powder is easily abraded and falls off during handling. The crucible cannot be washed because the devitrification powder would be removed in this process. As a result of handling and possible cleaning, the amount of devitrification promoter adhering to the crucible surface becomes nonuniform across the surface and nucleation efficiency is degraded.

The Office has acknowledged that Hansen does not teach the crystallization promoter is dispersed in a silica matrix (Official Action dated March 26, 2009, page 4, line 5).

Watanabe is cited to show a method of forming a crystallization promoter layer containing the promoter in a translucent quartz glass layer. The Office states (Official Action

dated March 26, 2009, page 4, line13) that the description of Watanabe reads on the claimed crystallization promoter dispersed in a silica matrix.

Watanabe describes a crucible which is produced by the following steps:

- (a) forming a pre-molding by feeding powdered a powder of naturally occurring quartz into a mold; (Col. 4, lines 54-67)
- (b) scattering the crystallization promoter on the surface of the internal wall of the crucible body; (Col. 5, lines 17-26)
- (c) forming a synthetic quartz glass layer by scattering and fusing a powder of silicon dioxide on the crystallization promoter-containing layer that is formed along the internal wall surface of said crucible base body. (Col. lines 27-33)

Therefore, since the promoter-containing layer is formed on the internal wall surface of the crucible base body, the crystallization promoter is not uniformly dispersed in the inside surface of the crucible. Watanabe describes that (Col. 5, lines 36-47):

The quartz glass crucible according to the present invention comprises an outer layer, i.e., a base body 3, . . . an internal layer 4 formed by discharging a synthetic silicon dioxide powder inside a high temperature gaseous atmosphere and allowing it to melt and scatter, thereby adhering the powder to the inner wall plane of the base body 3; and a crystallization promoter-containing layer 4a formed between the outer layer 3 and the internal layer 4.

The described layer arrangement is shown in Fig. 2. Nowhere does this reference disclose or suggest an inside surface comprising a transparent coated layer consisting of a crystallization promoter and a silica matrix, wherein the crystallization promoter is uniformly dispersed in the silica matrix as according to the claimed invention.

Moreover, Watanabe does not describe or indicate the mechanical strength measured by JIS K 5600-5-4 wherein the coated layer is not scratched by a pencil of 6H hardness and the adhesion amounts of the residual crystallization promoter on the surface do not change after acid washing.

Applicants again respectfully call the Examiner's attention to the following excerpt from the Office's own discussion of "Examination Guidelines for Determining Obviousness Under 35 U.S.C. 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*"

"The rationale to support a conclusion that the claim would have been obvious is that **all the claimed elements were known in the prior art** and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art at the time of the invention."<sup>43</sup> "[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does."<sup>44</sup> **If any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art,**" (Federal Register, Vol. 72, No. 195, page 57529) **(Bold added)**

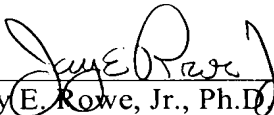
As described above, Watanabe a two layer structure of an outer layer of fused silicon dioxide and an inner layer of crystallization promoter. Hansen describes an adhered layer of crystallization promoter only. Neither reference alone or in combination describe at least an inside surface comprising a transparent coated layer consisting of a crystallization promoter and a silica matrix, wherein the crystallization promoter is uniformly dispersed in the silica matrix as according to the claimed invention. Therefore, the cited combination of references does not disclose or suggest all the claimed elements and according to the KSR guidelines, a conclusion of obviousness cannot be supported.

Based on the foregoing, Applicants respectfully submit that the cited combination of references cannot render the claimed invention obvious. Accordingly, withdrawal of the rejection of Claims 14-16, 18-19 and 21-22, 24 and 26 under 35 U.S.C. 103(a) over Hansen in view of Watanabe is respectfully requested.

Applicants respectfully submit that the above-identified application is now in condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

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